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Procedia - Social and Behavioral Sciences 197 (2015) 135 – 139

Procedia
Social and Behavioral Sciences

7th World Conference on Educational Sciences, (WCES-2015), 05-07 February 2015, Novotel Athens Convention Center, Athens, Greece

Students' Understanding Physics Concept of Traction Therapy

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Abstract

Physics behind the medical care continue fascinates for medical science. Specially, traction therapy is widely performed in clinical situation as manipulation is a common problem treatment for orthopedic surgery patients. The Physics concept involves with traction therapy is Force and Motion. This article, therefore, builds on and contributes to work on learning how nursing students conceptual abstract principle in Physical therapy case. Participants were nurse students took Physics for Nurse Course in the first year of their Undergraduate education. This work used system thinking approach as teaching intervention and assessment tool to evaluate students understanding. Baseline research interest, two physical therapy situations; cervical and femur traction were proposed. Based on research objective, both cases were composed of integrating the scientific knowledge into the system thinking diagram and illustrating the scientific knowledge from the system thinking diagram into a word or assay. After seeing the typical response, less than a half of students groups could identified core content of Physical therapy such as the Newton's first law, Newton's third law (action-reaction force), Balance forces and Gravitational force. However, this learning strategy encouraged students to integrate knowledge into virtual problems.

Peer-review under responsibility of Academic World Education and Research Center.

Keywords: Force and Motion; Nursing Student; System Thinking; Traction Therapy

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Peer-review under responsibility of Academic World Education and Research Center.
doi:10.1016/j.sbspro.2015.07.069

1. Introduction

Orthopedic surgery or orthopedics is the medical specialty that focuses on injuries and diseases with conditions involving the musculoskeletal system. Musculoskeletal system includes bones, joints, ligaments, tendons, muscles, and nerves and allows moving, working, and being active. Some link between Physics and medical care could be observed from the report of Keevil (2012). Typically, physics plays a vital role in cultivating the knowledge of natural sciences and establishing the foundation of logistic and scientific methods. The application of physics to medical sciences has been developed in practice for centuries (Hsu & Hsu 2012). From the point of view of higher education, this may also be moving physics into the class of nursing, classical subjects that are more relevant to medical care's needs.

System thinking, an approach to generate knowledge and understand phenomena in terms of cause and affect (Hogg & Zollman, 2002) by examining the linkages and interactions between components as an array of interactions, is drowned in several disciplines such as environment, management, engineering, education and science education (Yuruk, Beeth, & Andersen, 2009; Shaw, 2012; Stocklmayer, Rayner, & Gore, 2012; Feldman, 2011; Terzella, et.al., 2008; Portillo-Velez, et.al., 2013). Typically, the structure of system's behavior in system thinking is a feedback loops which root causes are not individual. The reason is that phenomena are understood to be an emergent property of interrelated whole not by breaking them into parts. However, over ninety nine percent of the encounter problems can understand with the simple thinking approach called event oriented thinking. Therefore, the goal of this work is to investigate how student conceptualized Physics concept involving traction therapy by employed system thinking to learning instruction.

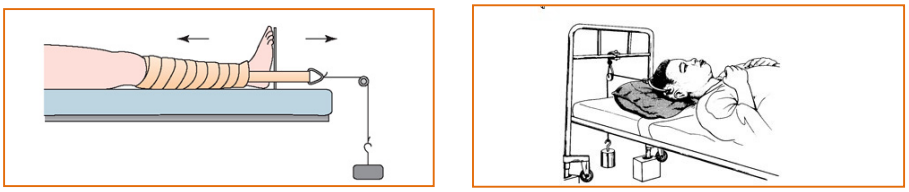
2. Physics of traction therapy

Traction is a clinical practice referred to as a pulling force in order to extend or hold a human body in a desired position for a long time to treat muscle or skeletal disorders. Therefore, type of traction is divided to skin and skeleton traction. The fraction is applied in the direction in which the weight is applied. Hence, it works on Newton's third law of motion principle which states that every action (force) in nature there is an equal and opposite reaction (forces are exerted on different objects). Skin traction use lighter weights (5-7 pound = 2-16 kg) or counterweights to apply force. On the other hand, skeletal traction use in case of skin traction is not appropriate for the body part needing treatment. This treatment is a long term period requires heavier weights of 11-18 kg). In traction therapy, bed is elevated to counter traction which let the body weight of patient oppose the pull of the traction. In case of lower limp need traction, foot side of bed is elevated. Head side of bed is elevated in case of traction is applied on the skull. Human body can be act as mechanical apparatus. Lever for movement is bone and its fulcrum is situated at the joint. Weight of the moving part is the load acting at its center of gravity and contraction of muscle produce the bone movement. Length of the load arm can be determined from position of the center of gravity of the moving part. Pulley alters the direction in which the force is acting. Femur and cervical traction are examples of skeletal traction (Thayalan, 2007). Pulley system which consists of a rope slides around a disk is used to change the direction of the tension force in a rope. Most case of pulley problems appear in high school and University Physics course is idealized for both pulley (massless and frictionless pulley) and rope (massless and do not stretch). This somewhat unrealistic parameter causing most students could not apply their learning knowledge to analyze or solve real world physics problem in realistic.

3. Learning instruction

The intent of this work focused on investigation of students' perception on physics concept of traction therapy. The simple approach, therefore, event oriented thinking, was engaged to learn and assess students' perception on force concept in traction therapy. For instructing physics concept of traction therapy, 99 first-year students from nursing program were asked to take in group of eight for brainstorming and provide a drawing to expose their ideas about traction therapy. Students were asked to complete "Physics concept relate to traction therapy". This study employed two common traction therapy; femur and cervical therapy (see Fig.1). Identification of students' prior knowledge for alternative conceptions as well as scientific conceptions from their responses on each event was our

main goal. Therefore, data were analyzed by reading student's drawing carefully to identify their ideas and grouping the same drawing structure in a given category. Video recorder was useful for observing students' response and conversation. The collected data includ students' drawing, spoken dialog, camera views of each student and the peer leader.

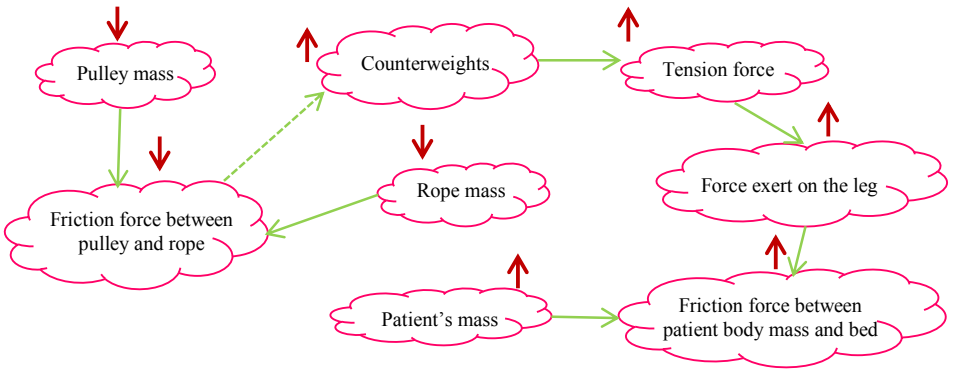


(a) (b)

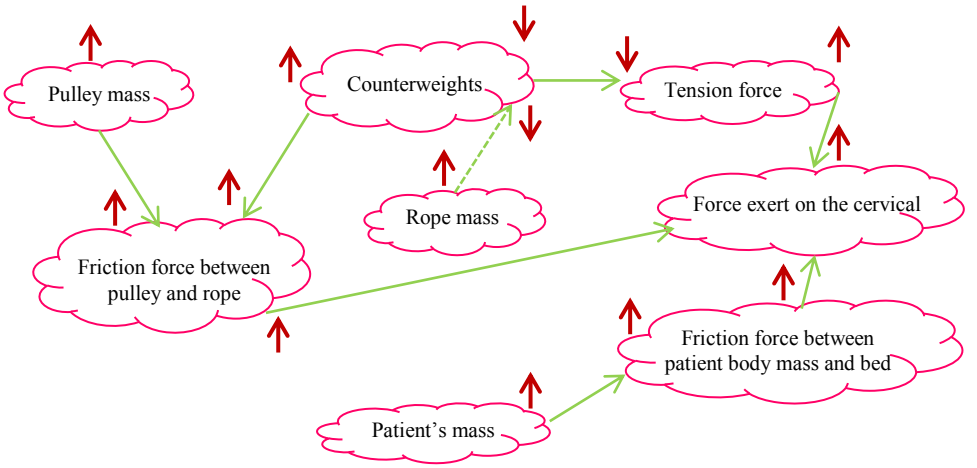
Fig. 1. (a) Femur traction and (b) cervical traction therapy.

4. Students' perception on force and motion

To obtain students' understanding of force and motion, therefore, the written artifacts including scratch work were meditated. Through more events, students were work through the questions "What parameters relate to the event?" and "How each parameter effect to each other". The results found that our students struggled to grasp the first question as they hardly ever integrate knowledge into their real life problems. From their scratch papers, we noticed that they attempted to use words from question to express as cause and effect diagram. After that, they ask for the choices to probe their idea on scientific knowledge. Hereafter, we found that students could illustrate cause and affect correctly over 50% [Fig. 2(a)]. However, less than one of two identified these parameters related to core content of Physical therapy such as the Newton's first law ($\sum \vec{F} = m\vec{a} = 0$), Newton's third law (action-reaction force), Balance forces ($\sum \vec{F} = 0$) and Gravitational force (g). Although, students did not identify a simple relationship between mass and weight they realized that body weight (W) is direct variation with body mass (m) according to $W = mg$ from previous study ("weight of sled and cart increase as mass of sled and cart increase") (Fig. 2). Then, the use of similar situation for assessing student understanding physics concept in traction therapy was a case in point. As evidenced in the first response, it was not hard for students to express the relationship between each parameter as shown in Fig. 2(b). The summarized students' response which expresses their understanding about femur traction and cervical traction therapy illustrates in Table 1 and Table 2, respectively. The results indicated that students use of oriented thinking much more than system thinking as they express idealistic (Force exert on the leg equal to tension force) and realistic (Pulley mass → Friction force) pulley system for the same event.



(a)



(b)

Fig. 2. Example of student drawing on (a) femur traction and (b) cervical traction.

Table 1. Examples of students' perception about femur therapy event

Students' ideas	Students' perception
Pulley mass → Friction force between pulley and rope	A friction force is direct variation with two objects move or tries to move across each other. If mass of an object increase its friction force increase.
Rope mass → Friction force between pulley and rope	A friction force is direct variation with two objects move or tries to move across each other. If mass of an object increase its friction force increase.
Counterweights → Tension force	Tension force equal to mass of counterweights
Friction force between pulley and rope – → Tension force	Tension force is reverse variation with friction force between pulley and rope
Patient' body mass → Friction force between Patient' body mass and bed	Friction force between Patient' body mass and bed is direct variation with patient' body mass (moving object)
Tension force → Force exert on the leg	Force exerted on the leg equal to tension force
Force exert on the leg → Friction force between Patient' body mass and bed	Friction force between Patient' body mass and bed is direct variation with force exert on the leg

Table 2. Examples of students' perception about cervical therapy event

Students' ideas	Students' perception
Pulley mass → Friction force between pulley and rope	A friction force is direct variation with two objects move or tries to move across each other. If mass of an object increase its friction force increase.
Rope mass → Friction force between pulley and rope	A friction force is direct variation with two objects move or tries to move across each other. If mass of an object increase its friction force increase.
Rope mass – → Counterweights	If rope mass increase, it has to apply light weights for equilibrium
Patient' body mass → Friction force between Patient' body mass and bed	Friction force between Patient' body mass and bed depend directly with patient' body mass (moving object)
Tension force → Force exertet on the cervical	Force exertet on the cervical equal to tension force
Friction force between Patient' body mass and bed → Force exerted on the cervical	Friction force between patient' body mass and bed depend directly with force exerted on the cervical
Counterweights → Tension force	Tension force equal to mass of counterweights
Counterweights → Friction force between pulley and rope	- A friction force is direct variation with two objects move or tries to move across each other. If mass of an object increase its friction force increase. - Tension force equal to mass of counterweights - Friction force between pulley and rope is direct variation with tension force

4. Conclusion

Our finding illustrate that less of fifty percent of students could identify core content of Physical therapy. However, most students understand main points of core content in traction therapy such the effect of varieties of mass on traction force. Besides, they could illustrate some part of realistic pulley system. By understanding relationships between cause and effect in traction therapy, students may be better able to use event oriented thinking as formative assessment to learn and sole medical science problem. Hopefully, nurse students can develop an understanding of the variety of physics concept employed both across and within the domains of medical sciences of further works.

Acknowledgements

We would like to thanks Suratthani Rajabhat University.

References

Feldman, G. (2011). Dramatic (and Simple!) Demonstrationof Newton's Third Law. *Physics Teacher*, 49, 103-105.

Hogg, L. K. & Zollman, D. (2002). Model analysis of the structures of student models: An example with Newton's third law. *American Journal of Physics*, 70, 766-778.

Hsu, J.-W. & Hsu, R. (2012). Physics teaching in the medical schools of Taiwan. *Kaohsiung Journal of Medical Sciences*, 28, S33eS35

Keevil, S.F. (2012). Physics and medicine: a historical perspective. *Lancet*, 379, 1517-24.

Portillo-Velez, R. de J., Cruz-Villar, C. A., Rodríguez-Angeles, A., Arteaga-Perez, M. A. (2013). Master/Slave.Robotic System for Teaching Motion-Force Manufacturing Tasks. *Applied Mechanics and Materials*, 307, 84-88.

Shaw, M. (2012). I "Saw" Newton's Three Laws. *Physics Teacher*, 50, 480-481.

Stocklmayer, S., Rayner, J. P. & Gore, M. M. (2012). Changing the Order of Newton's Laws–Why & How the Third Law Should be First. *Physic Teacher*, 50, 406-409.

Terzella, T. Sundermier, J. Sinacore, J., Owen, C. & Takai, H. (2008). Measurement of g Using a Flashing LED. *Physics Teacher*, 46, 395-397.

Thayalan. (2007). *Bio-medical Physics for Nurses*. India: Jaypee Brothers Medical.

Yuruk, N., Beeth, M. E. & Andersen, C. (2009). Analyzing the Effect of Metaconceptual Teaching Practices on Students' Understanding of Force and Motion Concepts. *Research in Science Education*, 39(4), 449-475.